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*Science and Technology for Tomorrow's Aerospace Forces*

## **Success Story**

### **ADVANCED ELECTRONIC INSULATING MATERIALS OFFER HIGHER TEMPERATURE CAPABILITIES FOR NEXT GENERATION SYSTEMS**



Low dielectric constant polymers will provide the Air Force with significantly improved insulating materials for a diverse range of electronics applications directly benefiting US national security. These new polymer materials are tough, can handle high temperatures during manufacturing, have good adhesion to different types of surfaces, and are essential for fast signal processing, as well as high density and low noise electronics. These combined qualities allow for the production of lighter weight, highly efficient signal processing systems and offer tremendous potential for important commercial applications in the private sector.



Air Force Research Laboratory  
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## Accomplishment

Scientists at the Materials and Manufacturing Directorate's Nonmetallic Materials Division developed a new family of materials that will dramatically improve the high-speed integrated electronic circuitry supporting important military defense systems. These high-performance insulating materials, low dielectric constant polymers, can handle the ultra fast processing speeds and high temperatures the Air Force will need to operate and sustain next generation air and space systems. Applications include high-speed computers, space-based radar, satellite communications, high-resolution imaging, and miniaturized electronics packages.

## Background

Next generation air and space systems require even smaller microelectronic packaging. This is driving the requirement for new insulating materials with higher temperature operational capability and ease of high-temperature fabrication. Directorate researchers discovered a family of polymer materials that meets these stringent objectives.

Scientifically referred to as flexible, aromatic benzoxazole polymers (containing perfluoroisopropyl units), and more commonly known as low dielectric constant polymers, these advanced materials are crucial because they enable higher circuit density. The high-element density electronic chips currently in use in Air Force warfighting support systems are rapidly approaching their optimal performance levels. Making them smaller could lead to interconnect delays and reductions in the speed of the circuitry.

The directorate's research team demonstrated that low dielectric constant polymers exhibit extremely low levels of water absorption, which is important for integrated circuit processing. They also demonstrated that the thermal expansion, energy loss, and directional uniformity, all critical factors in producing a highly efficient insulation material, are well within the acceptable limits for integrated circuit applications. These combined characteristics make the behavior of the new insulating materials extremely predictable, while allowing higher temperature processing and needed assembly capabilities.

Measurements on films of the materials in the new benzoxazole polymer family resulted in typical dielectric values of 2.1 to 2.5 at one megahertz—values that are significantly lower than the state-of-the-art. This achievement is very important to the electronics community because smaller size electronic devices will soon require insulators with these newly achieved low dielectric values.

## Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTT, (800) 203-6451 and you will be directed to the appropriate Laboratory expert. (01-ML-01)